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ENVIRONMENTAL IMPACT

of
OIL and GAS EXPLORATION
and
PIPELINE OPERATIONS

in ALBERTA

DECEMBER 1971

ENVIRONMENT CONSERVATION AUTHORITY

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CONSULTING ENGINEERS - TOWN PLANNERS
LAND SURVEYORS

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EST. 1911

OUR FILE NO.

December 1, 1971.

Environment Conservation Authority,
9912 - 107 Street,
EDMONTON, Alberta.

Attention: Mr. W. A. Flook,
Research Co-ordinator.

Dear Sirs:

We are transmitting herewith our report on the Environmental Impact of Oil and Gas Exploration and Pipeline Operations in Alberta.

This investigation was carried out by Dr. A. E. Moss, with assistance from Mr. R. H. Savage, Mr. D. B. Horne, and the undersigned.

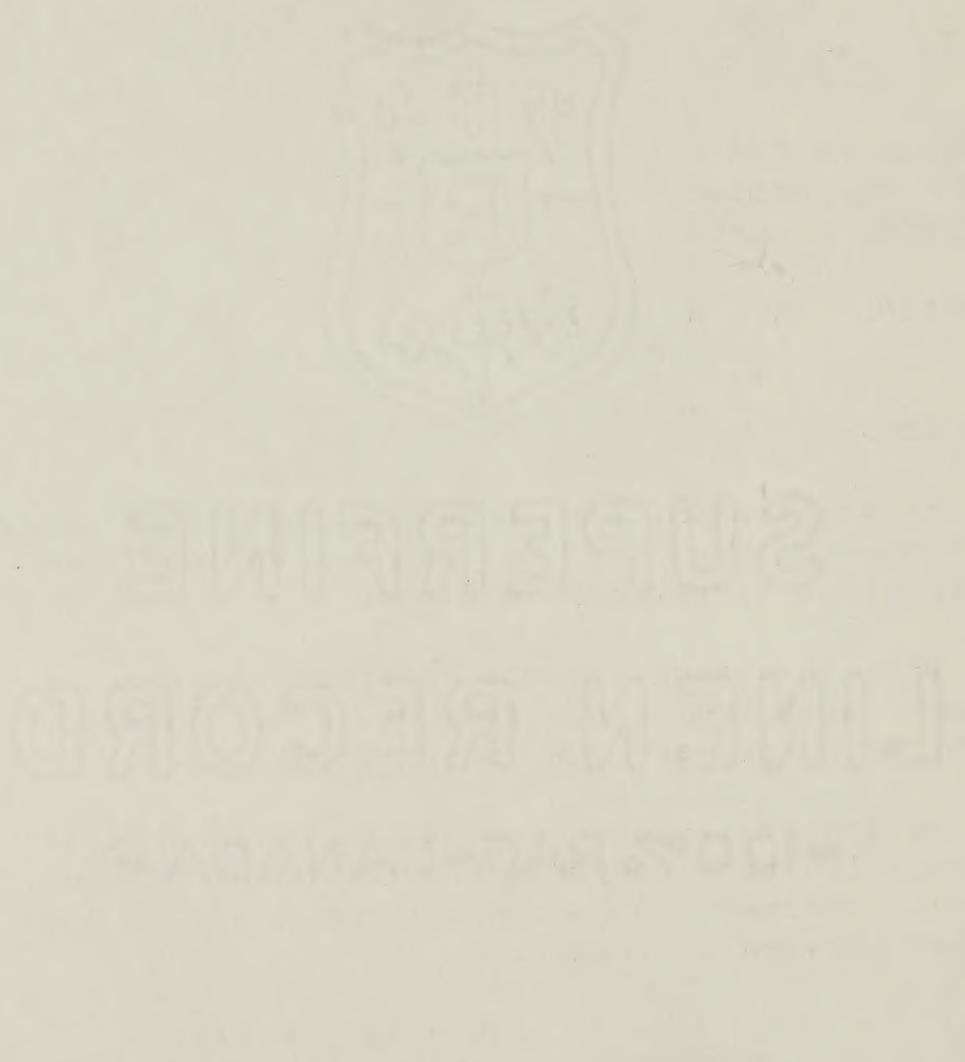
We gratefully acknowledge the assistance and co-operation received from the personnel of the various Government Departments contacted and also representatives of Industry.

Yours very truly,
UNDERWOOD MCLELLAN & ASSOCIATES LTD.,

Per:

A. R. Pasini, P. Eng.,
Branch Manager.

ARP/mmb.



ENVIRONMENTAL IMPACT OF OIL AND GAS EXPLORATION
AND PIPELINE OPERATIONS
IN THE
PROVINCE OF ALBERTA

ENVIRONMENT CONSERVATION AUTHORITY

by Underwood McLellan & Associates Limited
Engineering & Planning Consultants
11724 Kingsway Avenue
Edmonton 19, Alberta

December 1, 1971

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1. TERMS OF REFERENCE

Identify problems and implications to the environment of oil and gas exploration, pipelines, roads and other oil and gas activities. This is to include assembly of related data and an evaluation of the following:

1. Safety precautions to be taken to eliminate or minimize the effects on the environment. (Erosion control etc.)
2. Routing of pipelines - feasibility of corridor concept for a group of pipelines and roads.
3. Effects on biological resources, water, timber, wildlife and fish.
4. Present practise of repairing damage - recommendations on any changes deemed necessary.
5. The standards to which access roads should be constructed. Should roads be private or made available to the public for recreation purposes - hunting, fishing.
6. Proposed large diameter oil and gas pipelines. Any special precautions with regard to these lines.
7. Beneficial effects, if any, of oil and gas exploration and production works by opening up areas otherwise unaccessable for recreational uses.

8. Geophysical operations - determine if the multiplicity of seismic cut lines in close proximity can be reduced by co-operative efforts of the companies carrying out exploration work.
9. Erosion - examine area of research on re-forestation of rights of way and determine if additional work may be warranted.

2. INTRODUCTION

The consultants involved in this study have:

1. Obtained and studied the various government acts and regulations pertaining to oil and gas exploration and related activities.
2. Discussed various aspects of environmental impact with a wide variety of senior personnel representing government, the oil and gas industry and other interested organizations. (See appendix for a list of personnel with whom meetings were held.)
3. Visited three areas where oil and gas exploration and development has been carried out to observe and study actual field conditions.
4. Studied a wide variety of literature prepared by government and others dealing with different aspects of environmental impact.

There were nearly 17,000 producing oil and gas wells in the Province of Alberta at the end of 1970. In addition, there were nearly 1,700 capped gas wells and a number of abandoned wells. There were some 30,000 miles of pipeline serving the Petroleum Industry excluding several thousand miles of flow lines. During the past five years, over

50,000 geophysical line miles have been cut in the Green Area of the province, alone. In addition, a large number of battery sites, campsites and access road rights-of-way have been cleared to serve the Petroleum Industry of Alberta.

In view of the large acreage of the ground surface that has been disturbed by the above activities, it is not surprising that some damage to the environment has taken place. However, in spite of the scale of operations, it is considered that permanent damage is small and even temporary damage has been exaggerated. However, any damage is too much and government and industry must be constantly vigilant in their efforts to minimize the unfavourable impact on the environment caused by exploration and production activities.

3. SUMMARY

3.1 General Conclusions

The following general conclusions have been reached as a result of this study:

1. It is not possible to undertake oil and gas exploration programs, especially within the Green Area of the province, without disturbing the land's surface and causing some short term environmental damage. However, through cooperation between government and industry the damage can be minimal and, in fact, the long term impact, in many instances, may result in the improvement of the environment.
2. There is ample evidence that the Provincial Government and the Petroleum Industry are well aware of the impact on the environment caused by the Petroleum Industry's activities and are concerned with finding solutions.
3. Cooperation between government and industry, in working out equitable solutions to the many complex problems which have arisen regarding petroleum exploration activities, has generally been excellent although communication and liaison with each other could be improved.

4. The Provincial Government and the Petroleum Industry are actively engaged in programs to minimize damage to the environment caused by exploration for oil and gas.
5. Both government and industry have failed to acquaint the public or each other with the extent of their efforts to minimize environmental damage.
6. Pipelines that are constructed and operated under federal charters are not subject to provincial legislation.
7. The current timing constraints involving land sales that dictate "panic" approaches to seismic operations are responsible for unnecessary environmental damage because there is frequently a lack of time available for proper planning, program assessment and executing field programs.
8. News media reports, concerning the impact on the environment caused by petroleum explorations, have tended to exaggerate the extent and permanency of environmental damage. Conversely, the media have given very little attention to the beneficial effects that have resulted from oil and gas exploration and development. These reports have resulted in unnecessary

government expenditures and have discouraged many government and industry employees who are dedicated to protecting the environment from damage.

9. Government and industry are most cognizant of the potential damage which might be caused by oil spills and are cooperating closely in the immediate clean-up of any oil spill occurrence. However, potential hazards exist which could cause major damage and corrective measures should be taken.
10. There is a lack of adequate regulations concerning valve installation at key locations and the use of sensing devices to protect the environment from possible damage caused by oil spillage along major pipelines.
11. Flow lines do not belong in the same category as other pipelines and therefore regulations concerning routing, construction standards and inspection practices pertaining to flow lines cannot be the same as those for other pipelines.
12. The ever growing, intricate network of petroleum pipelines within developing urban communities in Alberta is seriously interfering with the orderly

planning of growth areas. Furthermore, the increasing amount of high value land that is being consumed for pipeline rights-of-way can no longer be justified.

13. Many remote areas in Alberta have become much more accessible as a result of oil and gas activity. This has a long term beneficial effect for the people of Alberta provided that field programs have been executed following acceptable standards.

3.2 Recommendations

It has been concluded that both government and industry are well aware of the fact that exploration activities may result in environmental damage. It has also been concluded that there has been excellent cooperation between government and industry. However, even though successful solutions have been found to a multitude of problems relating to the impact on the environment as a result of exploration activity, many areas require further attention.

Following is a list of recommendations that warrant consideration:

1. The Provincial Government and the Petroleum Industry

should embark on a continuing, coordinated educational program to inform all its employees and those of its contractors of the working procedures that cause environmental damage as well as the preventative measures required to minimize damage.

2. The Provincial Government should consolidate the Acts and Regulations pertaining to oil and gas exploration and related activities as well as to clarify some of the clauses.
3. The Provincial Government should establish a central government agency which would act as a clearing house and would be responsible for authorizing all field programs and land acquisitions related to petroleum operations. The proposed agency would have the responsibility of communicating with experts in all government departments concerned with field programs and land acquisitions and would provide petroleum companies with all necessary approvals and clearance documents.
4. It would be most desirable if a specific staff group within each petroleum company were designated to handle all dealings with the proposed government

agency recommended above. The practice of assigning to contractors the responsibility of obtaining clearance and approval documents should be discouraged by both industry and government.

5. The Provincial Government must continue and should accelerate the gathering of meaningful base line data of the renewable and non-renewable resources of the province. This data is invaluable for
 - a) government to assign the best possible land use so that maximum rewards for the use of this land will accrue to the citizens of Alberta and b) proper assessment of environmental damage that may be caused by exploration activities.
6. A comprehensive research program should be launched by government and industry into the causes and control of accelerated erosion which is now occurring in some areas being explored for oil and gas. Emphasis should be placed on prevention rather than restoration.
7. Soil surveys should be made by competent soil scientists of any area where accelerated soil erosion is now occurring as a result of exploration activity or of any area where it is suspected that the soils

- are susceptable to accelerated erosion. This has not always been done to the degree required.
8. The Provincial Government should consider the posting of bonds for field construction programs which would be returned when the project has been completed and inspection has determined that environmental regulations have been adhered to.
 9. The Provincial Government should consider scheduling land sales so that seismic work in high land value areas and those areas that are susceptable to accelerated erosion would be conducted in the winter months only.
 10. Government and industry should establish procedures whereby it would become unnecessary to conduct field programs, such as seismic surveys, within very restricted time periods and thereby appreciably reducing environmental damage. Land sales should be scheduled accordingly.
 11. The Provincial Government and the Petroleum Industry should make much greater efforts to acquaint the public with facts concerning environmental damage that has been caused by exploration activities as

well as the steps that are being taken to minimize future damage and restore the environment where damage has occurred in the past. The beneficial effects of exploration activities should also be publicized. The news media, including television, should be used in supplying the public with these facts.

12. A thorough investigation by government and industry should be initiated to determine procedures which would minimize the possibility of major oil spills entering lakes or water courses from pipelines. The investigation should include automatic sensing devices, the installation of automatic valves and inspection procedures for determining the condition of pipelines. Existing installations as well as new installations should be assessed. Some government regulations to increase environment protection would undoubtedly result from this study.
13. Consideration should be given to ensure that federally chartered pipelines within the borders of Alberta are subjected to Provincial Government scrutiny regarding right of ways, construction standards, etc.

This is believed to be important in view of the fact that it is inevitable that federally chartered, large diameter pipelines from the Arctic will traverse Alberta at some future date.

14. The provincial and municipal governments of Alberta should investigate the establishment of pipeline corridors especially in urban areas and at major river crossings. The feasibility of using the same corridors for highways, railroads, power and other services should also be studied. It will be necessary for the governments to cooperate with industry during these studies in order to obtain the necessary technological input from pipeline and petroleum companies.
15. Because of the large mileage of flow lines that are currently unregulated, regulations concerning all aspects of the construction and operation of flow lines deserve careful review by the Provincial Government.
16. The Provincial Government should investigate the possibility of making greater use of aerial photography and proven photogrammetric techniques for

assessing proposed seismic programs, route selection of roads, pipelines, battery sites, etc. and for the inspection of completed projects. It is believed that in some cases this work could be carried out more thoroughly, more efficiently and at less cost if aerial photographs and photogrammetric techniques were employed to a greater extent than is currently practiced.

17. Well site and battery locations should be more carefully assessed prior to approval when these facilities are planned near water courses or on steeply sloping ground. Some modification of regulations concerning the positioning of well sites may be required.
18. The government should require that approval of access road plans, including erosion control structures to be installed, be obtained where roads are to cross ravines or water courses.
19. Consideration should be given to amending the Canadian Fisheries Act to include silts and clays deposited in water courses and lakes as pollutants, if caused by man-made activities.
20. Studies should be initiated to determine if it is

economically feasible to make use of timber that is being cut during exploration activities and which is now being wasted.

4. OPERATIONAL FRAMEWORK

4.1 The Role of Government

It is the role of the Provincial Government to legislate enactments, administer these enactments and to carry out inspections of field operations. It should be stressed that government's role in fulfilling its responsibility to minimize environmental damage is made difficult because of the following conditions:

1. The tremendous extent of the area in the province where oil and gas exploration and development may occur, placing a heavy burden on the government to provide supervision and inspection over such a large area.
2. The great variety of terrain and climatic conditions encountered in different districts of the province and even wide variations within a particular district. These variations in field conditions make it desirable and even necessary to provide flexibility in government regulations so that the procedure for approval of programs, the supervision of programs and the final inspection can be varied depending on circumstances.
3. The geological conditions favourable for the

- accumulation of oil and gas vary considerably so that different exploration techniques are required in different fields. Thus, regulations must be flexible to accommodate these varied procedures.
4. The inability of the government, or the petroleum industry for that matter, to forecast accurately the magnitude of oil and gas exploration activities within the province. Thus, the desirable preparation and planning for exploration boom periods is seldom possible. The amount of exploration carried out in any particular year is largely dependent on conditions beyond the control of Alberta, such as, world and domestic market demands for oil and gas, the availability of risk capital for exploration programs, the internal and external economy, etc.
 5. The extreme difficulty of adequately protecting the environment as long as oil and gas exploration is carried out under "panic conditions", described in a later section of this report.
 6. The insufficient investigation of comprehensive land-use planning on a regional scale with respect to high value areas that may be reserved or limited

for uses other than petroleum activities. This is currently being remedied, to some extent, through such efforts as the Foothills Study.

7. In addition to the items enumerated above, the establishment of acceptable exploration procedures is made more complex because of the large number and diversity of disciplines that must be consulted or are directly involved in the legislation, administration and operational aspects of exploration programs. Geologists, petroleum engineers, biologists, civil engineers, pedologists, geophysists, botanists, lawyers, equipment operators, foresters, welders, zoologists, field foremen, chemical engineers, conservationists, drillers, technicians, environmental engineers and many other professions, vocations and trades are involved in some phase of oil and gas exploration.

Acts and Regulations

Government Regulations, concerned with oil and gas exploration and related activities in the Province of Alberta, are considered to be satisfactory by most civil servants and industry representatives who were contacted during this study. However, most agreed that there were

areas where improvements were warranted and many of those most intimately involved, have given much thought to specific changes. The fact that other provinces have drawn generously on the content of Alberta's Statutes for their own use and that foreign governments have eagerly sought advice from the Alberta Government on oil and gas matters, indicates that Alberta's enactments are held in high regard beyond our borders.

Some changes in the Regulations pertaining to specific areas have been suggested elsewhere in this report. However, it has also been pointed out that there is a danger of developing too many Regulations and thus eliminating the flexibility which is so necessary in Alberta due to the wide variations in field conditions. Additional and more exacting Regulations would increase the costs of administration and destroy some of the excellent co-operation that has developed over the years between government and industry. It is believed that better educational programs together with improved liaison and communication are the best courses to follow in order to assure that detrimental effects to the environment do not occur.

There is little doubt, however, that there is need for consolidation of the many Acts and Regulations now in force. This would be a substantial, but necessary, undertaking. Most provisions for government control have developed piecemeal over the past quarter of a century and for expediency have been distributed through a great number of government Acts. Such a situation is most confusing to industry personnel as well as to civil servants who are assigned the responsibility for the administration of the Regulations.

Clarification of some Acts and Regulations is also required. The need for modification of the administration and enforcement of government Acts and Regulations is discussed in the following section.

4.2 Industry's Position

The petroleum industry has its own peculiarities and methods of operation, which quite naturally are unlike those in other industries. It is not possible to formulate, implement or enforce realistic control procedures without considering these factors.

Firstly, the petroleum industry is intensely com-

petitive, (to a degree often unrecognized by the public) and this competitiveness is largely responsible for many of their actions which create problems of control. For example, repetitive seismic programs commonly are carried out by several companies over the same ground, programs are carried out with inadequate preparation, and government bodies are pushed for quick approvals.

In many cases it is necessary for petroleum operators to move quickly with large capital investments in order to protect or intensify their competitive position. This "hurry" approach, while sometimes considered unnecessary by the standards of others, has long since, and for good reasons, become a cornerstone of the industry.

Because of these massive investments, the "hurry" approach, their network of retail outlets and the current concern regarding pollution by the automobile, the petroleum companies are among the most visible members of the corporate community in the eyes of the public. These companies are therefore extremely conscious of their public image, and will go to great lengths to operate as good corporate citizens.

The key point is that pollution control is one of

the few areas in which petroleum companies have no need to be competitive with each other, in fact the practical and economic reasons for cooperation in this respect are overwhelming.

The main concerns of the petroleum companies are that control regulations be similar for all, so that their relative competitive positions are not jeopardized, and that any regulations take account of the unique nature of their business.

The Hurry Philosophy

Traditionally, and for good reasons, petroleum companies generally have operated on a "hurry hurry" basis. Since there is evidence that this approach may cause unnecessary damage to the environment as well as increasing operating expenditures for both government and industry, it is relevant to examine the contributing factors.

The tempo of seismic and exploratory programs is such that:

1. Companies often have insufficient time to plan their field program.

2. Government personnel have insufficient time to assess these programs.
3. Equipment operators may not operate with sufficient regard for the environment when they are working under pressure.
4. Standards of supervision and construction may be compromised due to pressures to get the job done.
It has been suggested, for example, that consideration be given to lengthening the lead time between the announcement date for land sales and the actual sale date, to allow competing companies more time for evaluation. Since the petroleum companies themselves often ask that land parcels be posted for sale, such an approach might tend to compromise their advantage over competitors. Would more lead time increase or decrease the income from land sales?
The environmental damage caused by the "hurry philosophy" certainly demands that the present situation be investigated thoroughly, but changes to the existing system should be made only after a complete assessment of all relevant parameters by both government and industry.

4.3 Liaison and Communications

The granting of land use privileges and the approval of field program requests are complex, time consuming, expensive and vitally important government responsibilities. This is true whether the land use authorization is in the form of a lease, licence, permit or sale. The difficulty is largely the result of the multiplicity of government divisions that must be consulted by the authorizing agency in order to obtain the necessary facts required to make a responsible decision.

Due to the multiplicity of divisions and the large number of persons involved in the granting of land use acquisitions and program approvals, the Petroleum Industry is also faced with complex, and frequently frustrating situations prior to receiving answers to their requests.

Construction and operating standards are decided, and sometimes administered, by a large number of government divisions and therefore good lateral communication within the government and between government and industry is essential if these standards are to satisfactorily serve their purpose.

Another area where close government - industry liaison is a necessity concerns the supervision and inspection of field programs. Here again, there is a multiplicity of government departments and agencies involved which causes confusion and uncertainty and reduces the possibility of attaining minimum environmental damage resulting from oil and gas explorations and related activities.

It is clear that adequate communication, which is essential for good liaison, does not exist among some sections of the government or in some cases between government and industry. This lack of communication is not unique as all governments and every large corporation are faced with communication problems in varying degrees of importance. In the structures that the Government of Alberta has established for dealing with oil and gas matters, a lack of communication can have undesirable consequences.

Vertical communication within government seems to have developed satisfactorily in most cases, but lateral communication is not as well developed. The lack of lateral communication within the government is probably due to a variety of reasons.

The breakdown of communication between government and industry is due largely to the lack of a spokesman who can speak with authority on behalf of all corporate members of the Petroleum Industry on the one hand; and the lack of an appointed agency who can authoritatively speak for all government departments on the other. There are many examples illustrating excellent liaison relations between individual corporations and certain segments of the government because good personal communication has been established over the years. However, these situations, while commendable, do not solve the overall liaison problem that exists between government and industry.

While the liaison problems are many and complex and their solution is beyond the scope of the study, it is evident that the first step necessary for attaining a solution is to improve the government structure and streamline the current liaison procedures. There is now existing sufficient mutual respect between government and industry which could form the cornerstone for more effective communication and improvement in the methods of procedure.

There is no government department that has all the necessary expertise on their staff to properly handle the multitude of tasks that must be undertaken with regard to land acquisition, program approval, the setting of construction and operation standards, field supervision and inspection. Nor is it believed the establishment of a super-agency containing all necessary expertise would be a practicable solution to the problem.

This study cannot take credit for being the first to recognize this lack of liaison as the government has been aware of it and recently steps have been taken to, at least, partially solve the problem, e.g.- the formation of such groups as: the Mineral Sales Referral Committee, the Advisory Committee on the Environment, the Inter-Disciplinary Committee on Pollution Control, etc.

However, although progress is being made, a more thorough review of government structure to deal with the industry is suggested. The procedures involved in order to develop a more workable structure for liaison with industry would require careful political considerations as well as cooperation among the many government depart-

ments and agencies which are at present involved with legislation, administration and inspection of petroleum programs.

It is suggested that there is a need for the establishment of a "Petroleum Agency" which would be given the responsibility of dealing with all requests submitted by members of the Petroleum Industry. The Petroleum Agency would act as a clearing house and would receive, process and provide the necessary documents or authorization for land acquisitions for program approvals.

The formation of a Petroleum Agency would be welcomed by industry and would enable the government to provide better service at less government cost. Maximum use would be made of the wide range of expertise now on the civil service staff and it is not likely that many additional staff would be required.

Hopefully each petroleum company would be encouraged to designate an individual or a group of individuals who would represent the company in dealing with government through the Petroleum Agency.

Better liaison and communication between government

and industry is also required during the day to day operations. Field monitoring and inspection of field programs should be clarified and should be assigned to a specific government division. Admittedly, this may be difficult to implement but deserves very careful consideration. The Energy Conservation Board is the logical government agency to provide the petroleum technology that is required in many aspects of supervising and inspecting field programs and operations. However, the Alberta Forest Service has field representatives stationed throughout the Green Area of the province and are well equipped to play an important role as advisors and inspectors of petroleum field programs. Their knowledge and concern for the protection of the forests, their detailed knowledge of the geography and history of the region, their ready access to transportation and communication facilities, the fact that they are patrolling the forests in the area on a continuing basis and the fact that they are living in or near the area being explored and are therefore quickly available in case of an emergency are facts that must be borne in mind when considering the appointment of field inspectors.

Satisfactory field monitoring and inspection would only be possible if communication and liaison between Forest Service personnel and the appropriate petroleum, technological expertise were well established.

It is the duty of the public and the news media to draw the attention of government and industry to any situation where regulations are being violated and damage is being caused to the environment or where current operations might result in environmental damage at some future date. Understandably, the news media will stress the most newsworthy aspects of the report and there may be occasions when some of the facts are omitted.

In cases where the complete facts have not been reported, it is most important that the government release a statement immediately following the initial publicity in order to rectify any false impression that may have been created so that the public may be in a position to evaluate the situation. It is unfair to civil servants and employees of industry who are dedicated to preventing environmental damage if all the facts are not presented to the public.

It may not be possible to explore and develop oil and gas reserves in Alberta, based on the present status of known technology, without changing the environment. However, it should be possible to minimize the detrimental effects and maximize the benefits so that the citizens of the Province will gain far more than they lose when the final balance sheet has been evaluated. It is important to note that changing the environment is not synonymous with damaging the environment. Patience is required, however, as nature recovers slowly once its environment has been disturbed.

In the past, damage to the environment, as the result of oil and gas exploration, has been widespread and in some cases the temporary damage has been intensive. However, it is clear that both government and industry have recognized past failings and during recent years have taken corrective measures to prevent environmental damage as well as embarking on restoration programs.

During discussions with government and industry, no complacency or resistance to the necessity of more effective control was evident, in fact, there is a strong desire of everyone to minimize environmental

damage. There is a great deal of respect now existing between government and industry and this fact will be a key to improving regulations and field procedures. An understanding of the peculiarities and constraints which exist for both government and industry must be borne in mind as each works towards the solution of environmental problems.

Closer liaison, more constructive dialogue and coordinated educational programs appear to offer the most promise of success for government and industry in their long range efforts to reduce environmental damage. Imposing detailed regulations for each procedure is not practical and, in any case, would not be conducive to mutual trust which is so vital for success.

4.4 Environmental Education

Existing programs for the education of government and industry personnel in the causes, effects, prevention and repair of environmental damage in the industry are not generally set up on a regular and comprehensive basis. Several points are pertinent in this regard:

1. The basic message that avoidance of environmental

damage is far preferable to repair of this damage must be transmitted to all levels of personnel involved.

2. The causes and effects of environmental damage are required background in order to obtain a good understanding of the reasons for regulations and for correct field procedures.
3. The problems of industry on one hand and government administration and inspection on the other must be communicated to all concerned for a proper appreciation of the necessity for specified procedures.
4. The oil and gas industry is highly competitive and therefore many of its activities are carried out in an understandably secretive manner. Environmental knowledge on pollution control is one element of industrial background that has no need to be considered in this light and should be freely shared.

Effective prevention and repair of environmental damage resulting from petroleum activities is to a large extent dependent on successful communication of the above points to industry and government personnel involved. Education programs designed to meet this need are there-

fore required through the continuance of existing seminars and expansion of a planned educational program to cover all individuals involved.

In spite of sound government regulatory measures, excellent supervision and careful inspection of the completed job; unless all personnel involved in the field work know the correct procedures and are convinced of their effectiveness and necessity, the completed job will be wanting. Best results will be attained when the initiative originates with the individual performing the job so that regulatory measures, supervision and inspection can be minimal.

5. GENERAL ENVIRONMENT EFFECTS

5.1 Environment Inventory and Land Uses

There are two very important reasons why Alberta should obtain, at the earliest date possible, a complete inventory of the renewable and non-renewable resources present in the province: (1) this information is necessary in order to reach a decision on land use before some activity takes place which might invalidate the use of the land for some other more important and more valuable use and (2) the information is required to enable the government to evaluate the environmental damage caused by some activity by being able to compare the present state of the environment with its condition prior to the commencement of the activity.

Included in the inventory would be base line data concerning wildlife such as the number of various species present in the area, the general state of their health, quantitative and qualitative data on water supply, the availability of plant food, description of nesting and spawning areas, etc. as well as inventory of forests and vegetation, soil types, minerals, beaches and other natural recreational facilities, etc. Priority of this

inventory survey could be given to high value areas.

Having this data available would enable the government to evaluate areas on the basis of their multi-use potential and decide whether or not the area should be thrown open for oil and gas development. Due to a lack of this type of inventory to date, it has not always been possible to make this judgement except in low value areas where the value of the land for other purposes was obviously limited.

Because of the lack of such an inventory, there are many cases where it is impossible to evaluate environmental damage caused by exploration as the true state of the environment prior to exploration is unknown.

The gathering of this inventory would be expensive and would require many years to complete. Furthermore, the data would have to be kept up to date or its value would be quickly lost. Presumably, this could be a joint effort with the Federal Government. Work on compiling this data bank has already started and the Foothills Resource Allocation Study is an example of such a program.

Although time consuming and expensive, it is doubtful if Alberta can afford not to conduct a continuing, long range inventory survey.

5.2 Recreation, Wildlife and the Environment

The use of the Green Area of Alberta for recreational purposes is wide spread and increasing rapidly. Many of the aspects of recreation are related to wildlife in such forms as hunting, fishing, photography, general observation and enjoyment of the aesthetic environment. Petroleum exploration and production activity is therefore significantly related to the recreational and wildlife aspects of land-use in the Green Areas.

Many of the direct effects of petroleum activity on the recreational value of any area can be defined, but the judgement on whether each effect is detrimental, beneficial or of no consequence is largely a matter of the set of values being applied. Some of these environmental impacts are listed below, with value judgements being reserved or made only in the more obvious cases.

Accessibility

Petroleum activity entails construction of access roads, seismic lines, pipeline rights-of-way, etc., which allow increased accessibility to forested areas,

especially by wheeled vehicles. Larger numbers of people usually make use of such an area than were able to prior to the petroleum activity. This also means more active hunting or fishing in an area with consequent effects on the fish and game populations. By and large these effects can be controlled by well planned fish and game management.

Erosion

The most serious effect on wildlife and general aesthetics due to oil and gas activity is caused by accelerated erosion. Large quantities of sediment entering natural water courses can destroy the spawning beds of game fish and destroy small animals on which game fish feed. Accelerated erosion also attacks shorelines causing destruction of trees and other vegetation, causing slumps, and removing shade which may raise water temperatures, thereby affecting fish life.

Evaluation of erosional effects includes determination of whether damage is permanent or not. Spring floods will normally flush silt deposits from streams. If erosion control programs are instituted, stream

siltation damage can be restored. The accumulation of silt in lakes is a much more serious problem as no economical method exists for removing it. Erosional effects and control measures are described in detail elsewhere in this report. The quantitative assessment of erosional effects is sometimes difficult due to a lack of base data to indicate the state or condition of streams and lakes prior to the onset of the activity causing the erosion.

Clearing

The clearing of timber for seismic lines, well-sites, roads, pipelines, etc. has a number of effects. Regrowth on these clearings is usually deciduous and provides an additional food source for the large mammal population.

Clearing of forested areas increases the amount of run-off and also increases the rate of evaporation. Tree removal affects the ground water table and in some instances increases stream flow volumes. The specific effect, particularly related to petroleum activity, can only be evaluated for each individual case and cannot be generalized.

One side effect to increased run-off can be accelerated erosion which was discussed previously.

Human Activity

Effects on wildlife by human activity which is necessarily associated with petroleum exploration or production are many. One of the most obvious is the direct effect on game population due to the presence of so many potential hunters over all periods of the year. The number of game animals killed out of season is unknown. A detailed evaluation of this aspect would be helpful since no reliable estimates exist.

Any intrusion into the natural habitat of wildlife will necessarily change the balance of the existing pattern. Certain species will move out of an area so affected. All of the ramifications of this element are beyond the scope of this report but are being actively examined by various provincial agencies and Fish and Wildlife groups.

5.3 Erosion

Gradual erosion of the earth's surface is a natural

process in the geological aging of the earth. However, when human activity causes highly accelerated erosion to occur, serious effects on the natural environment can result. Accelerated erosion of surface areas resulting from clearing and construction is probably the most serious form of environmental damage associated with oil and gas activity. This problem is recognized by both government and industry.

Causes

The removal of vegetation for clearing and construction of seismic lines, pipelines, roads, etc. provides open areas for the unimpeded flow of rainfall and snowmelt runoff. The extent of erosion resulting is largely related to:

- (a) the susceptibility of soils to erosion by runoff;
- (b) the quantity and intensity of precipitation;
- (c) the gradient of slopes in the area;
- (d) the amount of area over which vegetation is removed; and
- (e) the manner in which clearing or construction has taken place in relation to the ground contours and natural watercourses.

Prevention

The control of accelerated erosion resulting from petroleum activity can be attempted through avoidance of conditions conducive to erosion at the outset or through restorative measures after construction work is finished. The prevention of erosion is always far more effective than repair or control after the fact.

Prevention of all erosion would mean practical elimination of all extensive human activity in any given area. This would only be justified in the case of petroleum activity if careful study indicated that other land uses for that area would be of greater value to Alberta than the value of gas and oil that may be produced and that oil and gas activity prevents the land from being used for other purposes. This aspect is discussed under Environment Inventory and Land Use.

A number of techniques can be employed to prevent accelerated erosion during and subsequent to oil and gas activity.

- (a) Reduction of the amount of land to be cleared through careful joint planning with government and industry of roads, joint usage of seismic lines,

use of roadway-pipeline corridors and other consolidation of uses to minimize the required clearing. The current practice in program approval recognizes the necessity of joint planning but more emphasis on this aspect is warranted.

- (b) Careful location of roads, pipelines, well-sites and other elements with regard to natural land forms and drainage courses, avoiding large cuts and fills and interference with natural drainage. Improved planning and field supervision of earth moving projects would be of assistance in this regard.
- (c) Petroleum companies should be required to submit plans of all proposed drainage course crossings.
- (d) Accelerated educational programs on the causes and effects of construction procedures for all levels of staff involved.
- (e) Consideration of "winter-only" seismic programs in erosion susceptible areas.
- (f) The use of adequately sized drainage structures, ditch checks, etc. in the original design of access roadways.
- (g) Spreading of natural vegetation on newly constructed slopes and ditches.

Restoration and Control of Erosion Damage

At the present time, both industry and government recognize the erosion problem and efforts to prevent erosion and develop technology for restoration of eroded areas are well advanced. Major erosion problems remain, however, in areas that were subject to activity prior to the recognition of the problem. Some of the ways in which eroded or potential erosion areas can be treated are listed below.

- (a) Correction of drainage patterns that have been adversely affected by construction.
- (b) Re-vegetation of slopes using local research into suitability of ground cover, mulches, fertilizers, soil types, etc.
- (c) Proper preparation of exposed slopes for re-vegetation through reduction of slope gradients, contouring, etc.
- (d) Extensive application by field personnel of such techniques as are specified in "Guides for Controlling Erosion", a booklet prepared by the Department of Lands and Forests, in all phases of field operations.
- (e) Elimination of the necessity for the haste with

which most construction is carried out, thereby allowing more planning and better design.

There is ample evidence that industry and government are cooperating in controlling erosion. The existing areas of difficulty in obtaining effective results are related to a lack of good field supervision in application of restoration techniques, a lack of extensive local information on soil types, suitable vegetative cover, mulches and fertilizers, and a lack of ongoing maintenance of ground cover through fertilization.

It is emphasized that preventive measures are always far more effective than restorative measures and as such should be applied vigorously from the outset in any field program.

6. FIELD OPERATIONS

6.1 Seismic Surveys

Considerable environmental damage may result if seismic surveys are not well planned and properly executed and therefore authorization of this work as well as field procedures deserve careful scrutiny.

The major concerns relating to environmental damage as the result of seismic surveys are:

1. The amount of forest cover destroyed in line cutting.
2. The problems of erosion created by the removal of vegetation on lines causing excessive silting of water courses and lakes.
3. The government costs incurred in approving programs, monitoring field programs and performing field inspections in order to prevent or, at least, minimize environmental damage.

It is somewhat surprising to learn that up until the present time the acreage of land cleared for seismic lines is greater than or equal to the acreage of timber cut by the forest industry on an annual basis. However, it must be kept in mind that a high percentage of seismic line clearing, perhaps 50 percent, is located in areas that do not contain commercial

timber. Also, most seismic line clearings will become re-forested naturally although the species of trees in the new growth will likely change. Only a very small percentage of the timber cut can be salvaged economically along seismic lines at the present time, because the cuts are not concentrated and much of the timber is damaged during the line clearing operations.

The government is aware of the desirability of reducing the mileage of seismic lines necessary in order to assess the oil and gas potential of an area. The spacing of seismic lines is regulated and some flexibility in spacing is allowed depending on the local geological conditions. Additional lines near already existing cut lines are no longer permitted. The joint use of lines by several companies is encouraged at all times. Where joint use of lines is practiced there are certain difficulties in equitably distributing the restoration costs. Experimental tests are now being made whereby each company is assessed a fee per mile and the government assumes the responsibility of restoration when all seismic work has been completed.

Much less damage to the environment would result

if all seismic work could be confined to the winter months, as far less disturbance of the protective covering occurs during winter clearing. Trees tend to break off at bulldozer blade height leaving the base of the tree trunk and the root system more or less intact if clearing is undertaken in the mid-winter period.

Restoration under these conditions is simplified.

Obviously, all geophysical work cannot be done in a five month period because of the problem of finding sufficient crews to carry out the work. Furthermore, geophysical companies would face serious staff problems if work was to be confined to only half the year. However, it is suggested that careful planning of land sale dates could result in confining seismic work in high land value areas or in areas where the soil is highly susceptible to erosion to the winter months. Seismic work in these areas could then be prohibited during the summer months. It is recommended that this problem be given serious consideration by the government.

In high value land areas or areas that are highly susceptible to erosion, consideration should be given to prohibiting the use of wheeled vehicles along seismic

lines. Tracked vehicles cause less disturbance of the ground and their use would greatly reduce the need for detours.

It is believed that other regulations pertaining to the protection of the environment from damage by erosion are generally satisfactory.

Approval of Geophysical Programs

Approving geophysical programs is an extremely important and time consuming government function. The examination of proposals must be thorough if serious environmental damage is to be avoided. It is urged that petroleum companies devote more attention to the proposed location of seismic lines, bearing in mind possible erosion and pollution problems. Maps and written submissions should be factual and complete so that the government has all the necessary data on which to base a decision. Recently, maps showing proposed line locations are not accepted unless they are carefully prepared on a scale of one inch to the mile. This stipulation makes the procedure of assessing the program much less time consuming. Changes in line locations from those approved should not be allowed.

More time should be allowed for the appraisal of proposed programs. The present panic conditions under which most seismic programs are undertaken seriously hampers the careful study that is warranted. This is especially true if an important parcel of land is to be placed on sale and many companies are filing programs simultaneously. It is suggested that consideration should be given to the examination of line locations, using stereo pairs of aerial photographs, so that the examiner can obtain a much better appreciation of the topography and its relation to problems of pollution.

Line Inspection

Line inspection is a necessity and is largely undertaken, in most areas, by walking the lines. Inspection from vehicles, snowmobiles or horseback can also be used. Inspection of lines using fixed wing aircraft or helicopters is expensive and not entirely satisfactory. It is believed inspection by the examination of aerial photographs would be more complete and less costly in many cases.

6.2 Access Roads

The ultimate total use of main access roads is seldom

fully known at the time the road is planned as its use is dependent on the quantity of oil and gas discovered during the exploratory period, the distribution of the finds within the area and the number of different operators involved in the various activities. Thus, it is not always possible to place the road in the optimum location or to set construction standards that are compatible with the amount of traffic using the road or the length of time that the road will be required.

However, in spite of the unknowns, it is recommended that more thought be given to route planning of access roads as well as to construction standards. It is also recommended that maximum sharing of roads be encouraged and that only under special circumstances should more than one access road be allowed into each area.

Current regulations stipulate that proposed route locations within the Green Area must receive authorization from the Department of Lands and Forests. However, some deviation from the proposed route is permitted, if warranted by field conditions. If routes were carefully planned by making use of stereo-paired aerial photographs

and proposed routes were checked by similar methods, deviation from the planned route would be minimized. It would be desirable to have the proposed route drawn on aerial photographs when submitted.

Although petroleum companies might be expected to set high construction standards in order to reduce maintenance costs, such is frequently not the case. The failure in this regard may be due to the fact that the companies do not exert sufficient pressure on the construction contractors to follow prescribed standards. Unless petroleum companies are prepared to set and enforce good road standards such as correct and adequate ditching, installation of properly sized culverts, ditch checks, etc., the government should establish minimum standards for all access roads. Many of the existing access roads are served with undersized culverts and money spent on repairs is much more than it would have cost to carefully plan and properly design the road, initially.

Following roadway completion, cuts or fill slopes are grassed and the owner is required to correct any poor construction procedures that might cause serious erosion problems. Probably, the width of rights-of-way could be

reduced in many cases unless it is planned to accomodate power service lines, pipelines, etc.

Many access roads eventually become public roads and their maintenance becomes the responsibility of the provincial or municipal government. Because the route and construction standards have a great influence on maintenance costs, it would seem that the government should insist on playing a more active role in control by route location, design, construction standards and field construction procedures.

6.3 Pipeline and Pipeline Corridors

Government regulations pertaining to pipeline construction and operation are not stringent although the standards set forth by the Canadian Standards Association are followed. Of course, pipeline companies are held responsible for any damage that pipeline failure may cause. It may be believed that no strict government regulations are required in view of the fact that the Petroleum Industry holds their public image in such high regard. Therefore, they are most unlikely to carry out construction or operation in a manner that could result

in a major oil spill or other significant environmental damage. The value of the argument is questionable as it is comparable to saying that there is no need for traffic laws because the driver has too much to lose if he breaks them.

Pipeline Design

The subject of installation of automatic shut-off valves at critical points along pipelines should be thoroughly investigated. The placing of automatic valves at both sides of river crossings and at any other points where pipe failure could result in large quantities of oil entering a water system, should be examined. Although the Alberta Oil Spill Contingency Plan is doing an excellent job, Alberta cannot afford not to take every possible precaution to prevent major oil spills.

Careful consideration should also be given to the use of some type of automatic sensing device that would immediately alert authorities should an oil spill occur along a pipeline.

Consideration should be given to enactments that would assure proper examination of the condition of installed pipelines as well as continuing maintenance.

Federally Chartered Pipelines

Federally chartered inter-provincial pipelines should meet the minimum Alberta construction standards. Also, the route of these pipelines should be discussed with the appropriate provincial authorities prior to the commencement of construction. It is likely that all presently operated federally chartered pipelines meet the minimum standards as undoubtedly these companies have tremendous incentives to operate safely. Not only is their public image at stake, but a break in these large pipelines, unless quickly controlled, could cost them very large sums of money because of product loss. Apparently very little study has been devoted to the routing or standards of large diameter Arctic pipelines that will undoubtedly cross the province at some future date.

Flowlines

Flowlines are normally constructed along the most direct or least expensive route and do not require route location approval. Although it is not suggested that route location approval be required for each flowline, as this would be a very costly undertaking, it is recommended

that all flowlines crossing streams and routed where steep slopes exist be discussed with the government field inspector. As rights-of-way are normally cleared with a bulldozer, serious erosion problems could develop. Field inspectors should have the authority to request a change to the routing of a flowline if the proposed location is likely to cause unnecessary environmental damage.

Pipeline Location

The public is becoming more and more concerned regarding the routing of oil and gas pipelines. It is becoming increasingly more apparent that pipeline route proposals must be given much closer scrutiny than has been the case in the past. The laying of pipelines through farming or ranching lands has little or no effect on the use of this land for agricultural purposes. Neither do pipelines have any serious effects on the environment where they pass through low value areas unless permafrost is present or the area is susceptible to accelerated erosion. However, this is not the case in high value forested areas and in densely populated and urban districts. Pipeline river crossings and pipelines

routed adjacent to lakes or rivers also deserve special attention.

It is suggested that a referral committee be established, similar to the Mineral Sales Referral Committee that was formed last spring to assess potential environmental damage of areas to be offered for sale by the Department of Mines and Minerals. The purpose of the proposed committee would be to assess proposed rights-of-way for pipelines with regard to land use and possible environmental damage.

Pipeline Corridors

It is inevitable that the concept of pipeline corridors must become an accepted approach to solving the problems caused by the multiplicity of pipeline rights-of-way that criss-cross many sections of Alberta. Consideration must be given to limiting the amount of land that is being assigned to pipeline rights-of-way especially in urban areas. The restrictions placed on land use in these areas due to randomly located pipelines is seriously interfering with the orderly planning and urban development of the ever growing municipalities. Alberta can no longer afford the luxury of allowing

pipeline companies to install pipelines along the most economic routes from the pipeline company's point of view.

The problems associated with the use of pipeline corridors must not be underrated. Following recognition of these problems it is most important that solutions be found to them prior to commencement of actual planning of corridor locations. Some of the questions to be answered are: Will the corridor have a common ownership or will each pipeline company own their own right-of-way within the corridor?; Who will own the corridor and how will its cost be shared?; What are the rights and responsibilities of each pipeline owner?; What are the legal implications?; Will the corridor be used solely for pipelines or will it also be used for highways, railroads, communication services, power lines, etc?; What safety precautions will be required?; Are there serious problems from an insurance point of view?; and finally what are the technical and engineering problems regarding the construction and operation of pipelines within a common corridor?

6.4 Oil Spills

One of the major concerns of the Petroleum Industry, the Provincial Government and the general public is the possible damage to the environment which may occur as the result of an oil spill. Alberta is most fortunate in this regard, as pollution control cooperative committees have been established at various locations within the province as recommended by the Alberta Oil Spill Emergency Plan. This contingency plan was set up by the Environmental Conservation Committee of the Canadian Petroleum Association in cooperation with the Provincial Government. These pollution control committees have assumed the responsibility of making certain that any oil spills that occur in their respective areas are cleaned up as quickly as possible.

The committees are organized by all the companies operating in the area and a chairman is selected from the staff of the major oil producing company from each area. The first committee was established in the Pembina field and it has become the model of some 20 similar committees throughout Alberta. Both British Columbia and Saskatchewan have adopted similar plans

based on the Alberta scheme. Enquiries concerning the plan have been received from many parts of United States and from other foreign countries. Manuals have been prepared containing detailed contour and cultural maps of the districts, complete inventories and location of equipment and supplies required for clean up operations, communication procedures to be followed depending on the size and nature of the spill, telephone numbers and addresses of all government and company personnel that might be involved in a spill and a description and location of oil spill control points throughout the area.

There has obviously been a tremendous amount of thought and work expended on the setting up of these plans. Their establishment is an excellent example of industry and government cooperation and strongly indicates the desire of the Petroleum Companies to be good corporate citizens of Alberta.

Probably the most newsworthy event concerning the Oil Spill Contingency Plan occurred this summer when the Pembina Committee, with government approval, released 45 barrels of crude oil into the North Saskatchewan River. 44 of these barrels were recovered

using a variety of material and equipment such as booms, skimmers, absorbents, straw, pumps, snowblowers, etc. The information obtained from this experiment will be most valuable during the clean up operations for future spills.

Oil spills are caused by equipment failure, human operating errors and actions from outside the industry including vandalism and even sabotage. It is doubtful if oil spills can be entirely eliminated so that good oil spill clean up programs are essential. Alberta has one of the best clean up plans in existence.

All oil spills should be reported to one government agency regardless of its source or the magnitude of the spill. It is most important that the Energy Resources Board and the Department of Lands and Forests continue to be involved with oil spills, the former because of its petroleum technological knowledge and the latter because of the availability of widely distributed field personnel and its ready access to communication and transportation facilities.

APPENDICES

MEETINGS HELD

Alberta Fish and Game Association
Gordon Peel - Past President

Alberta Government

Energy Resources Conservation Board
Lloyd A. Bellows - Asst. Manager Field Operations
Vern Jones - Superintendent of Field Operations -
Edmonton Area
Department of the Environment
H. W. Thiessen - Director Interdepartmental Planning
Division
Cooper Drabble - Special Consultant
Harvey L. Hogge - Director of Pollution Control
Division
R. E. Bailey - Director of Water Resource Division
B. Boyson - Executive Engineer, Water Rights Branch,
Water Resources Division

Department of Industry

Les Collins - Deputy Chairman on Task Force Pipeline
Corridors

Department of Lands and Forests

Alberta Forest Service

R. G. Steele - Director
G. M. Smart - Head Land Use Branch
A. J. Facco - Land Use Coordinator
W. J. Kammermayer - Geophysical Coordinator
J. J. Nowicki - Head Multiple Use Planning
E. C. Wyldman - Head Land Use Research
Rex Winn - Area Superintendent, Slave Lake
Lorne Goff - Fire Control Officer, Slave Lake
Ed Johnson - Land Use Specialist, Slave Lake
Glen Sloan - Forest Ranger, Slave Lake
Fred Sutherland - Area Superintendent - Rocky Mountain
House
Gerald Stuart - Land Use Officer - Rocky Mountain House
Ron Lyle, Forest Ranger, Prairie Creek Area
Cliff Henderson, Forrester, Clearwater Forester

Fish and Wildlife Division

Martin Paetz - Chief Fisheries Biologist
B. Kemper - Habitat Biologist
D. Neave - Senior Wildlife Biologist
E. Scheffler - Chief Wildlife Biologist

Department of Mines and Minerals

Pipeline Division
A. L. Berry - Superintendent

Minerals Division

Mike Day - Director

Ray Paradis - Inspector Geophysical Branch

Al Lymer - Inspector Geophysical Branch

Alberta Research Council

Dawson Lindsay - Soils Survey Branch

Amoco Canada

Pat O'Connel - Area Superintendent, Pembina District

Peter Krenkel - Petroleum Engineer, Pembina District

Canadian Wildlife Service

Dr. A. H. Macpherson - Regional Director

Dr. W. E. Stevens - Supervisor Wildlife Research

Century Geophysical Corporation of Canada

H. Evans - President

Edmonton Regional Planning Commission

R. N. Giffen - Director

J. Woodroffe

Gulf Oil Canada Ltd.

J. G. Gainer - Head of Environment Control

Interprovincial Pipeline Company

D. D. Burley

T. L. Kyle

Mobil Oil Canada Ltd.

Lorne Walker - Environment Control Engineer

Oilweek

Les Rowlands - Associated Editor

Shell Canada Ltd.

Martin W. Winning - Chief of Environmental Control

Texaco Canada Ltd.

J. M. Daly - Production Department

University of Alberta

Dr. Stephen Pawluk, Professor of Soil Sciences

P. Paetkau - Post Graduate Student - Biology

GOVERNMENT ENACTMENTS

Acts

Agriculture Act
Coal Mines Regulation Act
Clean Air Act
Clean Water Act
Energy Resources Conservation Act
Environment Act
Environment Conservation Act
Fisheries Act (Federal)
Forests Act (1962 & 1971)
Forests and Prairie Protection Act
Groundwater Control Act
Lands and Forests Act
Mines and Minerals Act 1962
Municipal Affairs Act
Municipal Government Act
Oil and Gas Conservation Act
Pipeline Act
Public Lands Act
Quarries Regulation Act
Surface Reclamation Act
Water Resources Act 1955 & Revisions 1971
Wildlife Act

Regulations

Forest Management Regulations
Forest Protection Regulations
Geophysical Regulations
Mineral Surface Lease Regulations
Oil and Gas Conservation Regulations
Public Lands Pipeline Regulations
Public Lands Surface Reclamation Regulations

FIELD TRIPS

Field Inspection trip to Swan Hills Area.

Field Inspection trip to Rocky Mountain House
and Strachan areas.

Visit to Drayton Valley to Investigate Oil Spill
Emergency Plan.

